Computer-aided system, and method for automated risk parameter identification and/or characterization

The present invention relates generally to the automated monitoring and/or management of risks and particularly to automated methods and systems for characterizing relative risks which are based on a multiplicity of preferred risk criteria. The invention may be applied in conjunction with the automated configuration, development and/or pricing of financial products, for example, but relates quite generally to appropriate monitoring and checking systems for risk products and/or populations.

One aspect of risk management normally relates to the consideration of one or more criteria which are associated with one or more events of interest. The possibility of predicting the frequency or the possible probability of occurrence of such events of interest has, in all cases, a value and a usefulness.

It is often the case that various people use different groups of criteria in order to predict the expected occurrence of the same (or similar) events. In many cases, the same person can use different groups of criteria in various situations or at various times. Methods and systems for comparing different groups of criteria are useful tools for selecting the criteria and configuring and also developing the associated products.

These considerations can be applied to the market for financial products and services. This relates particularly to insurances. The discussion below deals particularly with applications for such methods and systems in the field of life assurance. In the expanded sense, however, the disclosed methods and systems can

be applied to other types of insurances and also to other financial products which include management of risks (for example pricing and assessment of different groups of criteria which could be used when configuring and developing property insurances, mortgages, loans, securities etc.).

Life assurance (and health insurance) are continually developing. A relatively recent trend in the field of life assurance is the increasing occurrence of "preferred" products. These are products which involve taking into account whether the death figures are lower than the expectations for "standard life" (i.e. the average mortality figures for a healthy population). Insurance companies offer preferred products to those people and/or groups meeting selected criteria which point to a low mortality.

As has already been mentioned, it is not uncommon for different companies (i.e. insurance companies), particularly in Europe, to use different groups of criteria to identify those criteria which are available for preferred coverage, and/or different intersections to indicate the levels of one or more criteria which are associated with a preferred mortality. Comparing the products from competing companies or configuring new preferred products to replace or improve existing products may be difficult without using a methodology which takes account of such differences. Such comparisons may be useful particularly when selecting criteria and pricing particular products and also for determining the influence of the change of criteria or the concession of various exceptions from the criteria on the pricing and possible profitability of such products.

In particular, the invention achieves the aims in that, for automated risk parameter identification in risk

management systems using relative risk values for a multiplicity of products and/or populations, product and/or population data records stored accessibly in databases are taken as a basis for generating a lookup table containing risk parameters, in that a filter module is used to store risk classes in association with the product and/or population data records on the basis of the risk parameters from the lookup table, in that an analysis module is used to generate at least one expected value for a probability of occurrence of a definable risk event for each risk class and to store it in association with the risk event, in that a normalization module is used to normalize the expected value for the respective risk class on the basis of an average rate of occurrence of the event for the product and/or population data records to produce a relative occurrence parameter, and in that the analysis module is used to produce a risk characterization value for the respective risk class on the basis of the comparison of the relative occurrence parameters, with the risk characterization value determining the probability of occurrence of the risk event. For a specific combination of risk classes, a risk characterization value, for example, can be determined using the analysis module and can be compared with available empirical data records for the purpose of characterizing the product and/or the population, where only typical risk characterizations situated within a definable threshold value are associated with the risk class. Likewise, by way of example, one or more of the risk classes can be allocated a multiplicity of risk parameters, where the method is repeated with the risk parameters modified and the deviations from the expected values are stored in association with the risk classes. The analysis module can be used to determine, by way of example, correlation factors between the risk parameters on the basis of the population data files divided into risk classes and to store them in

association with the relevant risk parameters. In addition, one or more threshold values, for example, can be used to allocate each risk parameter a relevance flag for a particular population and/or product. The lookup table containing risk parameters can be generated at least partly dynamically on the basis of product and/or population data records stored accessibly in databases. For secondary risk groups, at least one separate relative occurrence parameter can be generated, for example. In addition, by way of example, when the data are compared with the empirical data stored in relevant memory units the data, if situated outside of a determinable fluctuation tolerance, can be aligned with the empirical data. The memory units can be accessible locally or in decentralized fashion via a network. The alignment can be effected using definable variance steps, even in the case of the risk parameters, for example, whereupon the deviation is redetermined using the method. The risk parameters may include the relative mortality risks, for example. By way of example, new risk classes can also be produced dynamically on the basis of at least parts of the relative occurrence parameters. In addition, the secondary risk groups can comprise at least sex and/or age of occurrence and/or smoker/non-smoker and/or policy duration, for example.

From what has been said, it is clear that, in their broadest interpretation, certain embodiments of the present invention related to computer-aided methods and systems for characterizing relative risks, for example the risks of death, for a multiplicity of financial products, for example preferred insurance policies. One or more of these embodiments may comprise the steps of identifying one or more risk classes which are associated with the multiplicity of products; determination of an expected rate of occurrence for each risk class; division of the expected rates of

occurrence by an average rate for the standard risks in order to determine a relative risk ratio for each of these risk classes; and comparison of the relative risk ratios for the purpose of characterizing the relative risks linked to the multiplicity of products.

As can easily be seen by a person skilled in the art, additional aspects and features can be found in the consideration of the individual description which follows for the embodiments shown, which show the best type of embodiments of the invention as an example from today's point of view, and in the claims which follow the individual description.

At this juncture, it should be recorded that the present invention relates not only to the inventive methods but also to a system for implementing these methods.

The text below describes variant embodiments of the present invention with a reference to examples. The examples of the embodiments are illustrated by the following appended figures:

Figure 1 shows a block diagram which schematically illustrates a system for an inventive embodiment.

Figure 2 shows a flowchart which explains part of an embodiment of a method and of a system for characterizing relative risks.

Figure 3 is a continuation of the flowchart from figure 2.

Figure 4 is a continuation of the diagrams from figures 2 and 3.

Figure 5 is a continuation of the diagram from figure 4.

Figure 1 illustrates an architecture which can be used to implement the invention. In figure 2, a flowchart explains part of an embodiment of a method/system for characterizing relative risks. In the case of this example, the risks under consideration are risks of death and particularly those which are based on a multiplicity of preferred risk criteria. The embodiment which is shown in this and in the other figures may be used, by way of example, for comparing and for assessing preferred classifications for risks which are used by different insurance companies in conjunction with their respective products. In such a case, different criteria are often used by one or more of the companies for determining which risks are considered preferred. The use of the embodiment shown in the figures allows comparison of preferred insurance products despite the differences in the preferred criteria which are applied by the individual companies. The illustrated system and method can likewise be applied by a single company for the purpose of configuring and/or pricing a product and also for the purpose of assessing individual risk exceptions, as described further below in more detail in conjunction with the figures.

As figure 2 reveals, the first step, denoted by method block 10, relates to the implementation of a predominance investigation and the compilation of the results. "Predominance" means the rate of occurrence of a criterion (or of criteria) in an insured population. If one of the preferred criteria is systolic blood pressure, for example, then information about the predominance of the values for systolic blood pressure and also about the values used as "intersections" or

limit values for classifying an individual risk as standard or as preferred is collected and input.

Block 12 shows the step of recording predominance data relating to an insured population. By way of example, an extensive group of laboratory data from insured applicants can be studied in order to collect information about the predominance relating to systolic blood pressure.

The next "step" in the method actually comprises two steps, which are symbolized by blocks 14 and 16. The measures portrayed by these blocks may be performed simultaneously or in any order. Block 14 shows the step in which the predominance of preferred criteria in an insured troop is determined. A troop is a risk classification which represents a range of incremental probabilities for the occurrence of an insurable event. The activity illustrated by block 14 is accordingly a determination of the rate of occurrence of the criterion in question among the members of a particular risk classification.

The activity illustrated by block 16 relates to the calculation of relationships which may exist between various criteria from the preferred criteria. The term "relationship" is not understood in the narrow mathematical sense of a particular second-order moment for a probability distribution. Rather, this expression is used in a sense which is intended to indicate the presence or a measure of the dependency between two or more variables (in this case two or more preferred criteria). In some cases, one or more criteria may be closely related to one another. In such cases, the effect of such criteria may be redundant to some extent. This type of relationship is discussed in additional detail in US patent application No. 10/291,301, which was submitted on 8 November 2002 and

was transferred to the proprietor of the present application. To the extent which is required for complete understanding and recognition of the present invention, the whole of US patent application No. 10/291,301 is to be considered part of the present discussion by way of reference.

The next step, symbolized by block 18, involves determining the predominance of all combinations of correlated criteria. In other words, a numerical portrayal of the predominance of every single combination of criteria in a population is determined.

As regards the work step which is portrayed by block 20, adjustments are made if particular combinations of criteria result in implausible or incorrect results. Further reference to US patent application No. 10/291,301 is used to explain that a probability of occurrence can be determined for any combination of criteria. These values may be arranged in the form of a matrix whose dimensions are equal to the number of preferred criteria which have been considered. Each location in the matrix is a "cell" which contains a value which is specific to a particular combination of criteria. The step portrayed by block 20 is executed in consideration of the fact that with a matrix of this kind a lack of consistency can occur in the values which have been produced for particular combinations. In this case, the value of the incorrect cell is replaced with a value which matches the pattern which has been set up by adjacent, plausible cells.

The results of this determination are then compared with empirical data which are accessible from the studies of many companies. This step is symbolized by decision block 22. If the predominance of various combinations therewith changes, which has been observed in plausible studies, changes are made to achieve

alignment with the study results. This step is shown by method block 24. If this alignment process produces anomalies with the matrix, such anomalies are ascertained and are corrected in the step which is shown by block 20. If the results of the predominance match the empirical examinations, the results of the predominance are stored, as indicated by storage step 50 (figure 3). As specified, the results of the predominance are stored for each combination of preferred criteria in relation to age of occurrence, sex, smoker status and duration.

Figure 3 shows another part of an embodiment of the present method for characterizing risks. The part of the method which is shown in figure 3 can be executed before, after or at the same time as the part of the method which was discussed with reference to figure 2. The part of the method which is shown in figure 3 relates to relative mortality (i.e. the death rate in preferred classes divided by the average mortality). The first step, illustrated by block 30, relates to the implementation and collection of data from an investigation about mortality. This investigative body includes information which is specific to each of the preferred criteria under consideration. An overview of this information is shown in figure 3 by block 32. In addition, other clinical/epidemiological data which are accessible in general in connection with the present preferred criteria are checked over (block 34).

On the basis of these overviews, a relative mortality coefficient is calculated for each criterion (block 36). As in the case of the predominance data, relationships with mortality data are likewise calculated among the various criteria (block 38). Finally, relative mortality coefficients are determined for all combinations of associated criteria (block 40). After these work steps, any anomalies in these data are

identified and resolved or "smoothed" (block 42). The relative mortality coefficients which have been determined for the combinations are compared with data from studies of many companies in order to determine whether these coefficients match the empirical data. This work step is symbolized in figure 3 by decision block 44. If the coefficients determined do not match the empirical evidence, the relative mortality coefficients are aligned with the empirical results. This work step is represented by block 46. Following the alignments, the data are checked for anomalies and any anomalies are corrected (block 42). If the relative mortality values do match the values which come from the studies of many companies, the data are stored, as indicated by storage step 50 in figure 4. As in the case of the data about the predominance, the results of the relative mortality are also stored for each relevant preferred combination according to age of occurrence, sex, smoker status and duration.

With further reference to figure 4 following storage of the results for the predominance and the relative mortality for each relevant combination of preferred criteria (storage step 50), the method continues, as figure 4 shows, by virtue of a group of specific base-preferred criteria being studied (block 52). The determination of the criterion in this step is usually specific to a customer or a company. This means that the criterion which is used by a particular company or by an insurance product to identify a specific risk is determined and the present method is used to calculate a fundamental relative risk ratio ("RRR") for this combination.

When the basic criteria have been determined, the data about predominance and relative mortality are extracted from the memory for these criteria (block 54). Following the extraction of these data, an RRR is

calculated for each risk class according to age, sex and duration, as indicated in block 56. A specific formula for calculating RRR is given in detail further below. The calculations for each risk class are based both on the data for the predominance and on the relative mortality and also on the preferred criteria which define each risk class.

The results of the calculation, illustrated by block 56, are stored in storage step 58, as indicated. The system then provides a user with the opportunity to assess alternative scenarios (decision block 60). Examples of alternative scenarios are illustrated by method blocks 62 to 72. These include a change in the intersection limits for preferred criteria (62), incorporation of new criteria (64), removal of criteria (66), addition of one or more new preferred risk classes (68), removal of one or more existing preferred risk classes (70) and changing the preferred classification system (72). If alternative scenarios are assessed, new criteria-specific predominance data and relative risk ratios are calculated (block 74). The results of the fundamental criteria of predominance and relative risk ratios are taken from the data which have been stored beforehand (58), and the newly calculated results for predominance and RRR with the new criteria are compared with the results which have been obtained using the basic criteria. These work steps are indicated in figure 4 by blocks 76 and 78. The method then determines whether the changes are acceptable (decision block 80). If this is the case, the results are stored with the new criteria (58). If the results are unacceptable, changes can be made and additional scenarios taking into account these changes can be assessed.

Following assessment of all desired alternative scenarios, or else if there are no alternative

scenarios to be assessed, the method progresses as illustrated in the flowchart in figure 5. The results stored in storage step 58 can be compared with known results available in the relevant industry or on the market if appropriate. This option is represented in figure 5 by decision block 82. In one application, the results relating to criteria which are used by a client company can be compared with those from industry in order to assess the competitiveness of the client company's risk classifications. This work step is shown by block 84 in figure 5. If the results of the comparison are acceptable, the method progresses as indicated by the "YES" branch which emerges from decision block 86. If the results of the comparison are not acceptable (for example if the compared criteria are not considered competitive) then the method allows alternatives to be assessed, as described above.

If the results of the comparison are acceptable or if no comparisons are made then the method continues as indicated by block 88. This means that client-specific values for the predominance and the RRR are taken from the memory and are used to calculate the mortality used in the pricing (block 90). In the form of a document (92), low and in particular high-precision death coefficients are produced and the death coefficients are stored as indicated by a storage step 94. The stored mortality coefficients can be used to compare the actual mortality experiences of the customer with the expected mortality values and to develop a pricing for the product.

The RRR results may likewise be used to assess preferred exceptions, as indicated by decision block 96. If this is the case, an RRR value for an individual applicant is calculated in order to determine the effect which such an exception would have on a mortality for the risk class (block 98). The average

RRR for the risk class is extracted (block 100) and is compared with the RRR for the individual applicant (block 102). As indicated by decision block 104, the exception can be admitted (block 106) if the individual RRR is less than or equal to the average RRR for the risk class. If the individual RRR is greater than the average RRR for the risk class then the exception can be rejected (block 108).

RRR values for a single applicant can also be calculated by using subcategories of criteria (for example medical criteria, criteria based on personal or family data, violent deaths etc). Decisions to admit individuals to a preferred class or to exclude them from this class can now be made on the basis of one or more of the RRRs from the subcategories. This tool allows an insurer to accept relatively good risks which would otherwise be rejected because a particular criterion is not met, or to reject relatively bad risks which would otherwise be accepted (for example by an individual who only just qualifies with regard to many criteria). The use of this tool is not limited to one specific group or subgroup of criteria. In connection with life assurance, such analyses may be carried out for other criteria such as motor vehicle reports, participation in dangerous types of sport or activities, flying, work abroad etc. This is because in practice any factor which influences an individual's risk of death, whether positive or negative, can be included in this tool when assessing the overall suitability for whether this person can be included in a preferred risk classification.

When the RRR results are not used to assess preferred exceptions, the method ends, as indicated by end block 110. It should be added that a new cycle of product development can begin for the same client (decision step 60), specifically as an assessment of an

alternative scenario. If no fundamental changes in the data occur then there is no reason to repeat the steps and procedures described above.

RRR formula: the relative risk ratio for a particularly preferred class depicts the mortality coefficient for this risk class in relation to the entire average rate of a full distribution of risks which are classified as "standard life" in the insurance process. The RRRs fluctuate according to sex, age of occurrence, smoker status, preferred risk classes and insurance period.

A respective risk class (R^t) can be defined by the following "n" criterion:

Preferred risk factor	Global min.	Class min.	Class max.	Global max.
Risk criterion 1	1	a	b	c
Risk criterion 2	1	d	e	f
Risk criterion k	1	l	m	n
Risk criterion n	1	x	y	z

Let $M_{pq...s...t}$ be the relative mortality coefficient for individuals who have a value of "p" for the risk criterion 1, "q" for the risk criterion 2, ..., "s" for the risk criterion k, ..., and "t" for the risk criterion n.

Let $P_{pq...s...t}$ be the relative predominance for people whose value is "p" for risk criterion 1, "q" for risk criterion 2, ..., "s" for risk criterion k, ..., and "t" for risk criterion n.

Using a formula of the splinter type, the RRR can be expressed as the ratio of R^t divided by R, where:

for (p=a to b) (q=d to e) (s=l to m) (t=x to y)

$R^t = (\Sigma\ M_{pq...s...t} * P_{pq...s...t}))$ divided by $\Sigma P_{pq...s...t}$

and

for (p=1 to c)(q=1 to f)(s=1 to n)(t=1 to z)

$R = (\Sigma\ M_{pq...s...t} * P_{pq...s...t}))$ divided by $\Sigma P_{pq...s...t}$.

There is a relationship between the values of the incremental matrix or splinter matrix, which are described in US patent application No. 10/291 301, and the aforementioned RRR. Each value of the multidimensional splinter matrix could be referred to as the RRR of a single person or of a plurality of people who exactly meet the criteria associated with this location in the matrix. In connection with the present application (i.e. the comparison of a preferred product based on a criteria group A with another preferred product on the basis of criteria group B), the comparisons of the RRRs equate to a comparison between a splinter group and another splinter group.

An example will be used to illustrate this aspect. Nine people will be considered who have different readings for the diastolic and systolic blood pressure values, as indicated in table 1. It would also be assumed that the splinter values (or the individual RRRs) associated with these readings are shown in the right-hand column of table 1 (the figures in the table are excessive for the purpose of illustration):

DBP	SBP	Splinter mortality
70	130	85.0%
71	130	95.0%
72	130	110.0%
70	131	86.0%
71	131	96.0%
72	131	111.0%
70	132	87.0%
71	132	97.0%
72	132	112.0%

The right-hand column headed "splinter mortality" shows the mortality of an individual with the precise blood pressure values, which are shown in the central and left-hand columns of the table, relative to a "standard" mortality (i.e. the average mortality in a group of healthy people). Accordingly, a person with a value of 70 DBP and 130 SBP would have a mortality of 85% of the average mortality. It will be assumed that company A provides a preferred product which has a criterion according to which a DBP of less than or equal to 70 is included, and company B provides a preferred product with a criterion according to which an SBP of less than or equal to 130 is included. From this group of nine people, the RRR for company A would represent the combination of three splinters (130/70, 131/70 and 132/70) or 86% (i.e. (85+86+87)/3). The RRR for company B would likewise represent the combination of three splinters (130/70, 130/71 and 130/72) or 96.7% (i.e. 85+95+110)/3). Although both the companies have qualified 33% of the total group for their respective preferred products, company A can offer a lower premium. In this example, company B would actually "lose" the person with the values 130/70, since this person can go to company A and benefits from a lower

premium. This would increase the mortality coefficient in company B further.

In view of the broad spectrum of preferred criteria which are considered by various companies and the relatively large number of criteria which form the basis of the individual products, such comparisons between competing companies and/or products would be difficult without a formal and computer-aided methodology. This simplified example is merely intended to explain the principle used.

The method and the system can be implemented using an easily accessible computer technology which contains input and output units, a processor and data stores. The operation of the system is controlled by a program code which implements the methodology which has been explained in the added flowcharts. It is not necessary for the method and system to require a single machine or for all components of the system to have to be at the same physical location. Alternatively, the method and the system may be implemented as a unit or a machine for a specific purpose which has been designed specifically for implementing the present invention.

The invention has now been described with reference to particular means and embodiments, but a person skilled in the art can identify the fundamental features of the invention. Various changes and variants can be made to align the invention with various uses and environments without departing from the concept and scope of the invention which are specified in the claims which follow.